

ICCAGRA

Naval Research Laboratory

April 6th-7th, 2010

Rickey Petty
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ARM Aerial Facility



U.S. DEPARTMENT OF
ENERGY

**Office
of Science**

**Office of Biological
and Environmental Research**



U.S. DEPARTMENT OF
ENERGY

Office of Science

ENERGY

LEADING BASIC RESEARCH
FOR A SUSTAINABLE FUTURE

ENVIRONMENT

UNDERSTANDING CLIMATE CHANGE AND
IMPROVING THE ENVIRONMENT

INNOVATION

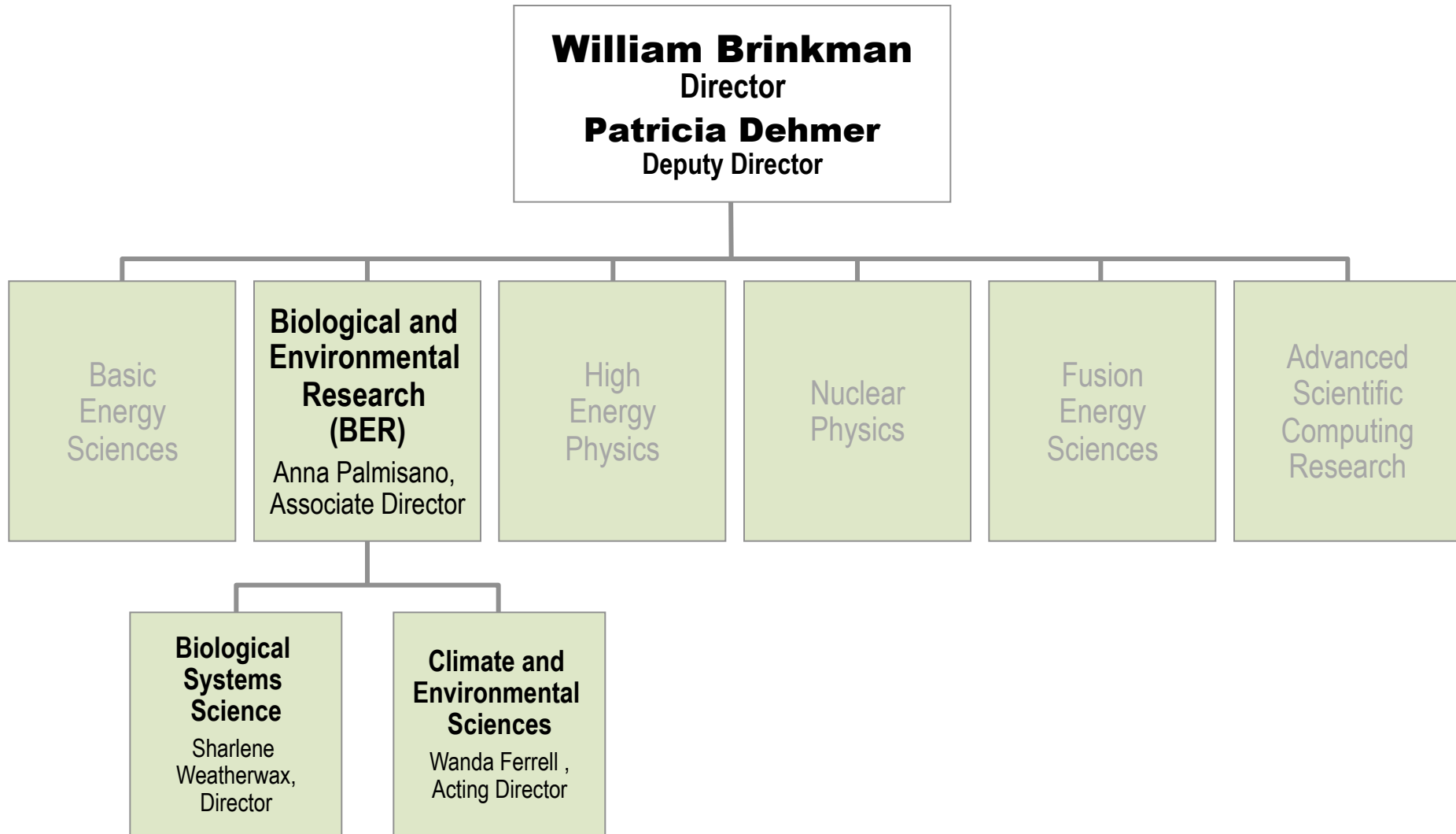
BUILDING RESEARCH INFRASTRUCTURE AND
PARTNERSHIPS THAT FOSTER INNOVATION

DISCOVERY

UNRAVELING NATURE'S
DEEPEST MYSTERIES

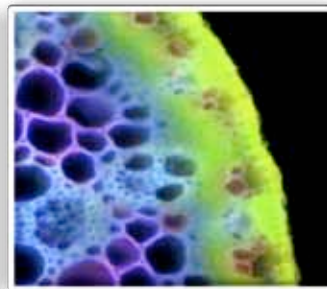
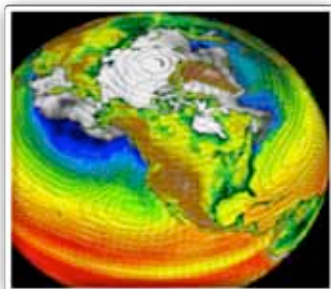
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Department of Energy Office of Science



Biological and Environmental Research Mission

- To understand complex biological, climatic, and environmental systems across spatial and temporal scales.
- BER provides the foundational science to:
 - Support the development of biofuels as major, secure, and sustainable national energy resources
 - Understand the potential effects of greenhouse gas emissions on Earth's climate and biosphere and the implications of these emissions for our energy future
 - Predict the fate and transport of contaminants in the subsurface environment at DOE sites
 - Develop new tools to explore the interface of biological and physical sciences



Biological and Environmental Research Divisions

Biological Systems Science Division

- Genomic Science Program
- Bioenergy Research Centers
- DOE Joint Genome Institute
- Low Dose Radiation
- Radiochemistry, Imaging, and Instrumentation
- Structural Biology

Climate and Environmental Sciences Division

- Climate Change Research
- ARM Climate Research Facility
- Subsurface Biogeochemical Research
- Environmental Molecular Sciences Laboratory

BER Climate Change Research

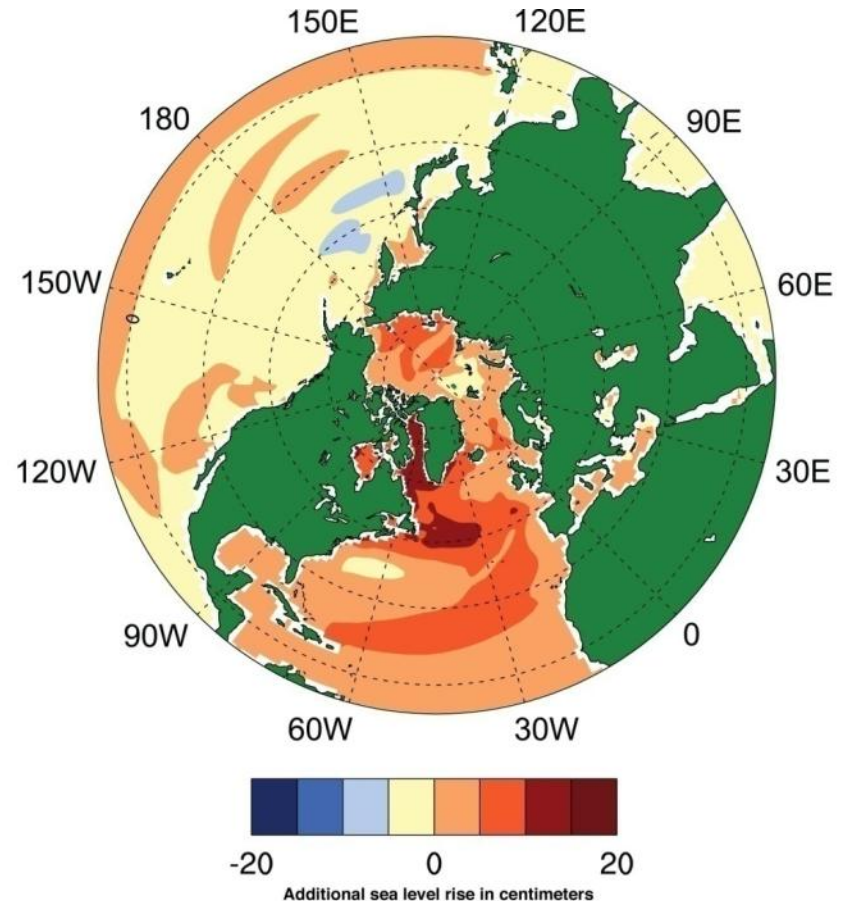
Strategic themes

1. Atmospheric System Research
2. Environmental System Science
3. Climate and Earth System Modeling
4. Facilities and Infrastructure



BER Climate Change Research: The energy-climate connection

“Advance climate change research to provide knowledge of effects of greenhouse gas emissions on Earth’s climate and biosphere—supporting effective energy and environmental decision making”

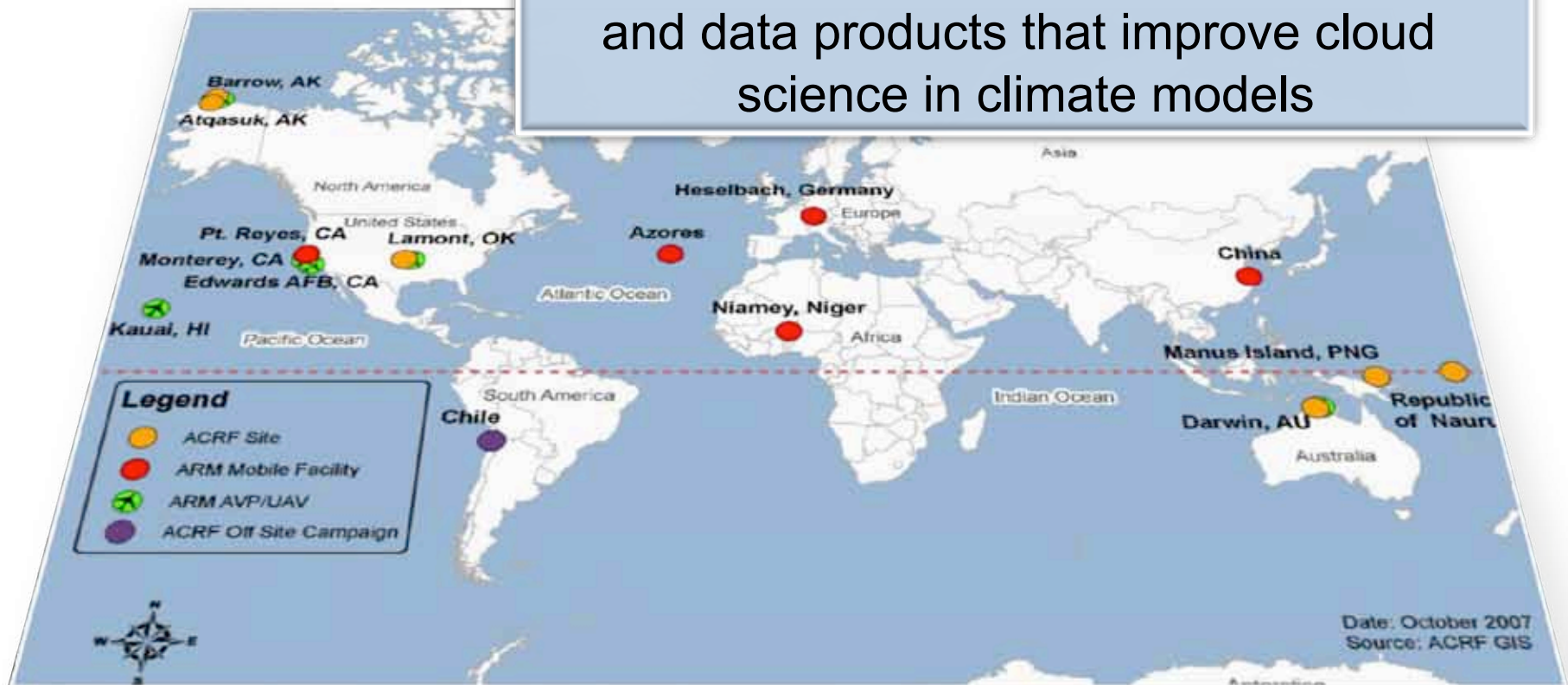


Modeling the impacts of climate change
Sea-level rise modeled with the
Community Climate System Model

DOE Scientific User Facility ARM Climate Research Facility



Provides continuous field measurements
and data products that improve cloud
science in climate models

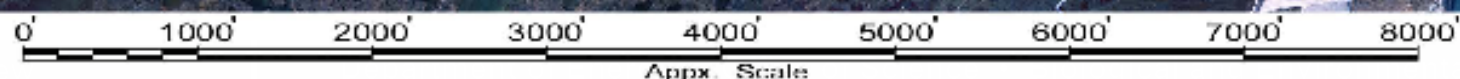


Federal Register/ Vol. 75, No. 52, 3/18/10

- Oliktok Point, AK: FAA 14 CFR Part 73
- Amendment of Restricted Air Space Area R-2204 High and Low
- Increase in authorized times of operation and extension of use beyond 2009

(Adjacent) ARCTIC OCEAN









ARM-UAV conducted 12 major field campaigns

Field Campaigns to date:

- Fall 1993, Edwards AFB, CA
- Spring 1994, Northern OK
- Fall 1995, Northern OK
- Spring 1996, Northern OK
- Fall 1996, Northern OK
- Fall 1997, Northern OK
- Spring 1999, PMRF Kauai, HI
- Summer 1999, Monterey, CA
- Winter 2000, Northern OK
- Fall 2002, Northern OK
- Fall 2004, North Slope, AK
- Winter 2006, Darwin, Australia



GA-ASI "GNAT 750"
(F93, S94)



Grob "Egrett"
(F95, S96)



GA-ASI "Altus I" (F96, F97)

GA-ASI "Altus II"
(Su99)



Proteus(F04, W06)

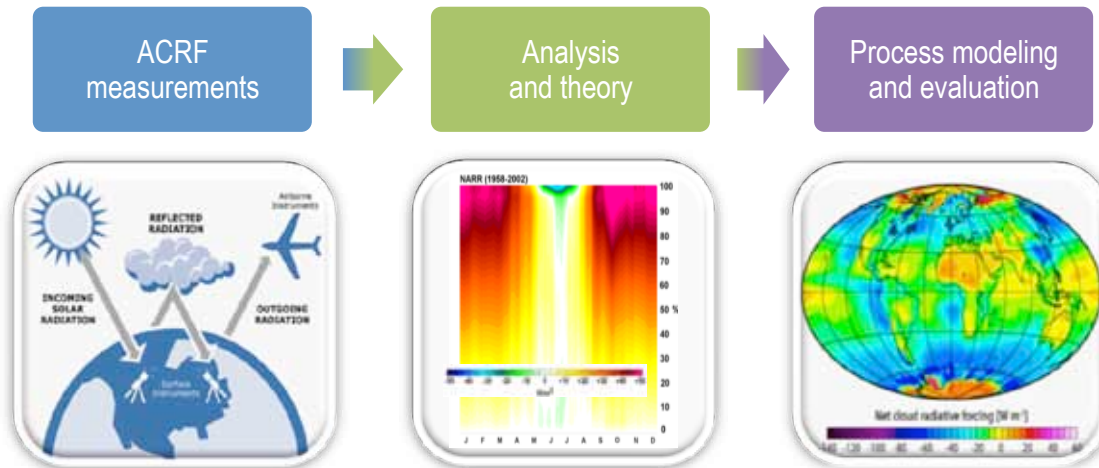


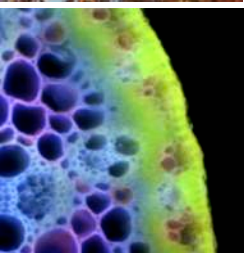
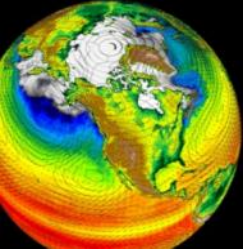
Twin Otter
(F93, S94, F95, S96, F96,
F97, Sp99, Su99, W00)

Atmospheric System Research



- Use of ACRF short- and long-term climate measurements
- Analysis, theory, process modeling, and retrospective climate simulations and evaluations
- Enhanced cloud and radiation formulations used to improve decadal climate predictions
- Improved scientific understanding of the atmospheric processes that drive aerosol radiative forcing of climate, including laboratory and field experiments, modeling, and instrumentation





Thank you!

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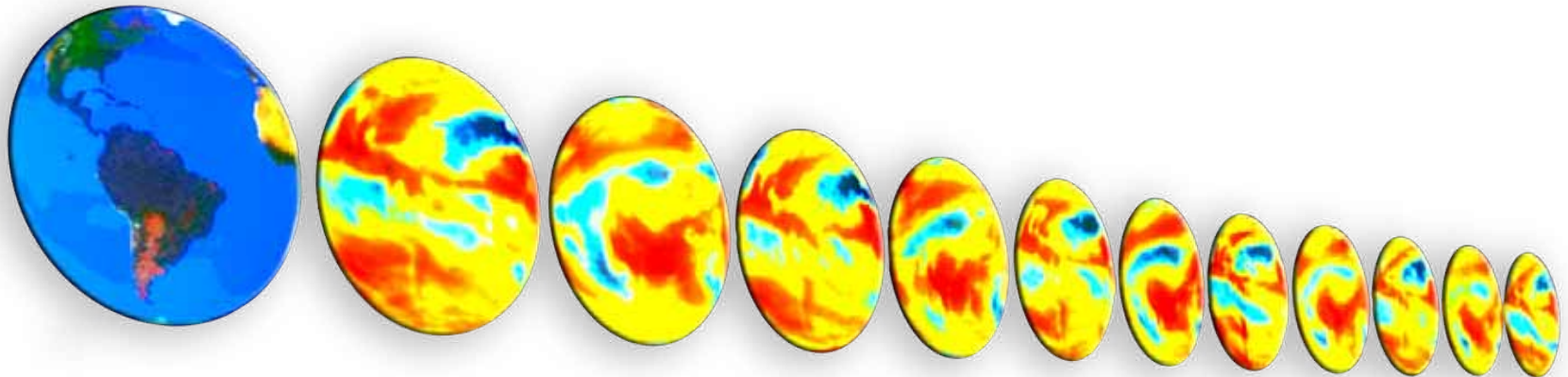
Biological and Environmental Research

Budget

Appropriations		FY10	FY11
Research	Biological Systems	\$166M	\$169M
	Bioenergy Research Centers	\$75M	\$75M
	Climate Change Research	\$134M	\$150M
	Subsurface Biogeochemical Research	\$50M	\$50M
	Total	\$425M	\$444M
Facilities: Scientific User Facility Operations	Joint Genome Institute (JGI)	\$69M	\$69M
	ARM Climate Research Facility	\$42M	\$46M
	Environmental Molecular Sciences Laboratory (EMSL)	\$52M	\$51M
	Total	\$163M	\$166M
Other	(e.g., Small Business Innovation Research)	\$16M	\$17M
	Total BER	\$604M	\$627M

Biological and Environmental Research Approach

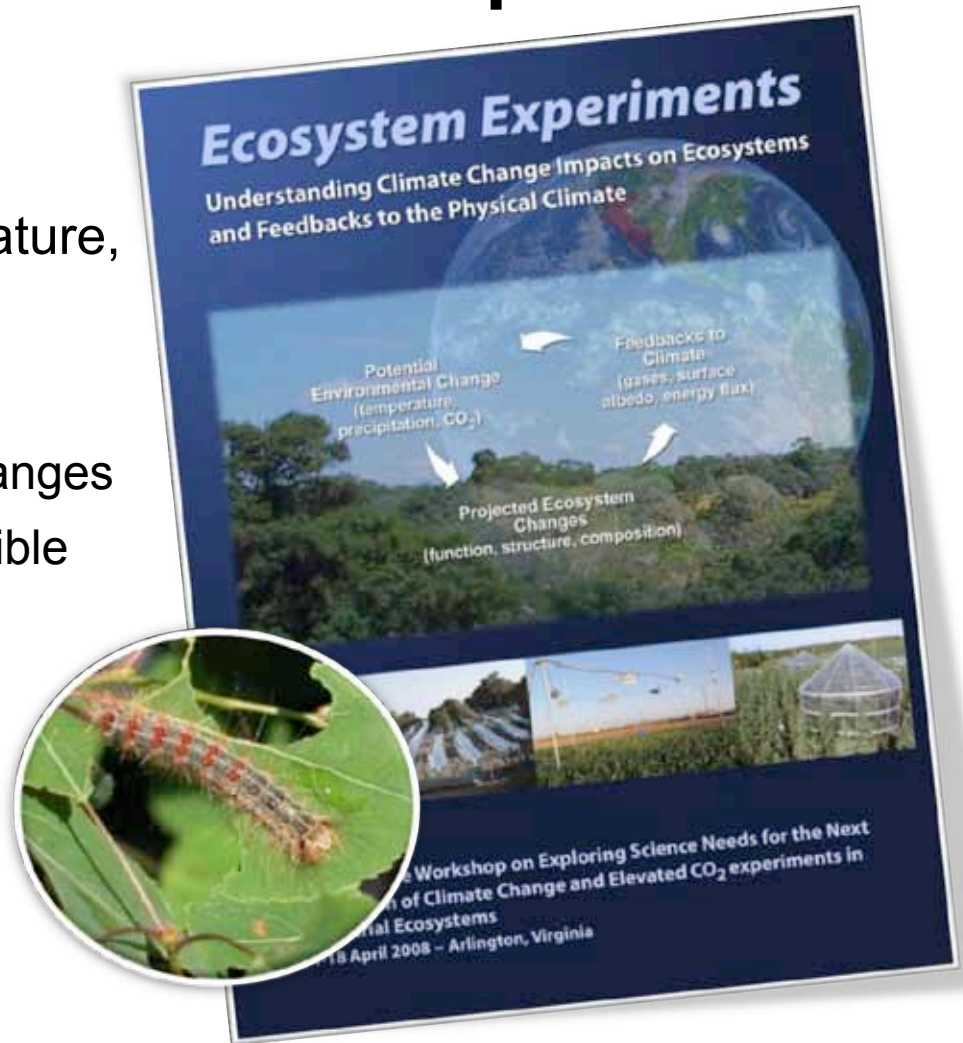
- Understanding complex biological and environmental systems across many spatial and temporal scales:
 - From the sub-micron to the global
 - From individual molecules to ecosystems
 - From nanoseconds to millennia
- Integrating science by tightly coupling theory, observations, experiments, models, and simulations
- Supporting interdisciplinary research to address critical national needs
- Engaging national laboratories, universities, and the private sector to generate the best possible science



Environmental System Science

Terrestrial Ecosystem Science – Impacts

- Develop and sustain unique, long-term, and ecosystem-scale experiments manipulating temperature, precipitation, and CO₂ levels
 - Quantify effects of warming on abundance of plant and animal species across their geographic ranges
 - Understand mechanisms responsible for plant mortality and altered plant-insect interactions induced by climate change
 - Quantify effects of warming on northward migration of plant species critical to ecosystem health



Terrestrial Ecosystem Science – CO₂ Fluxes

- Experimental and field-oriented program to:
 - Understand processes and mechanisms controlling the exchange of CO₂ between the atmosphere and terrestrial ecosystems
 - Develop process-based models
 - Improve reliability of global carbon models



CO₂ flux towers
and instrumentation

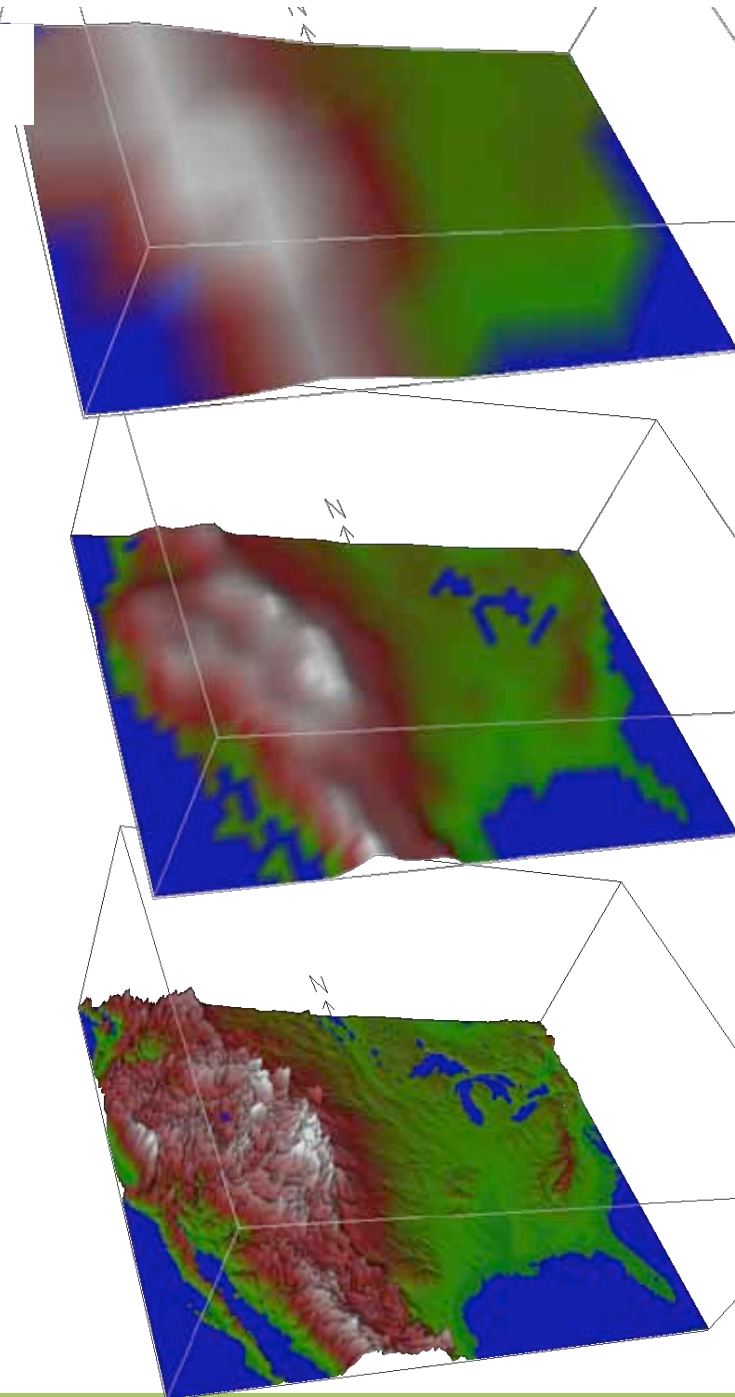
Terrestrial Carbon Biosequestration Research

- Supports basic research to understand how natural processes that control carbon biosequestration in terrestrial vegetation and soils can be modified to enhance sequestration
- DOE is the lead agency in the U.S. Climate Change Technology R&D Program



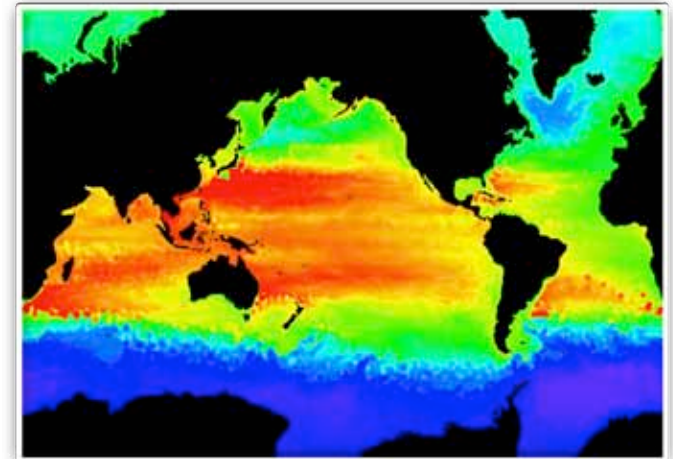
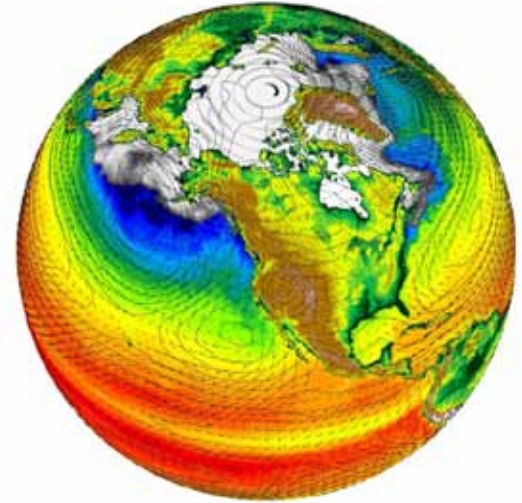
Regional and Global Modeling

- Develop diagnostic methods and tools to evaluate models
- Examine issues related to climate change detection and attribution
- Determine modes of variability change with changing climate
- Understand feedbacks in climate models
- Understand uncertainty in climate projections



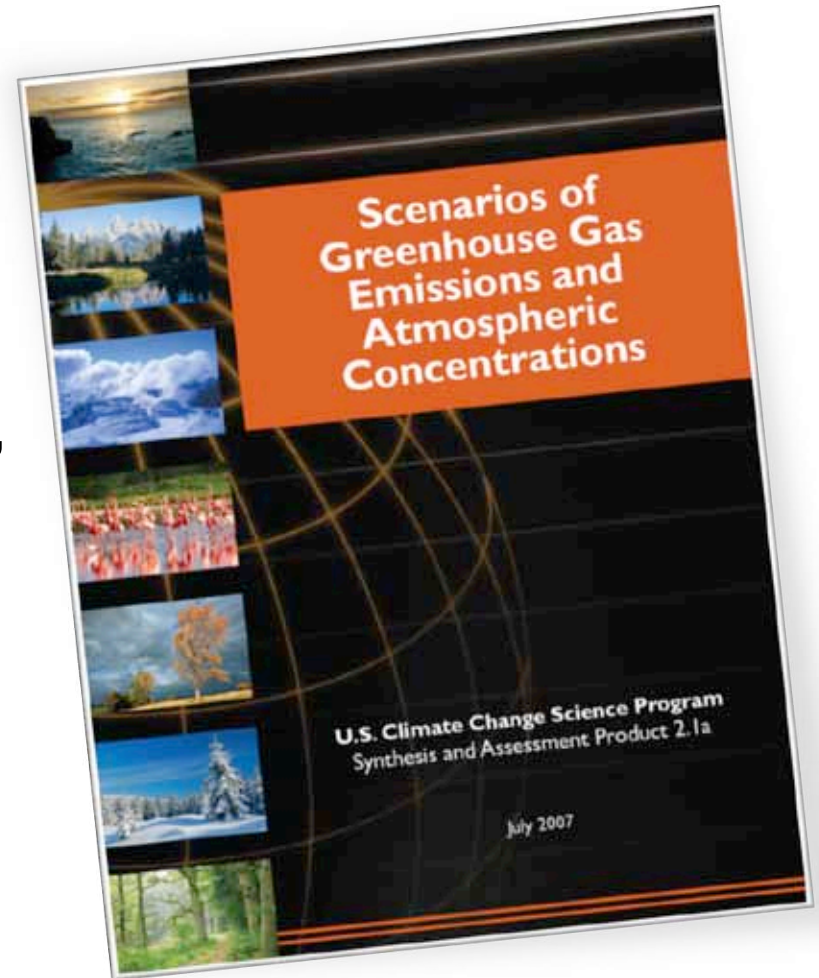
Earth System Modeling

- Develop models with strong theoretical foundations and improved representations of key climate processes
- Increase fidelity and throughput of climate change projections
- Utilize computationally intensive applications
- Couple individual process models
- Examine processes that have the potential to lead to abrupt climate change



Integrated Assessment Research

- Understand and model the complex interactions of human and natural systems
- Explore developmental pathways, emissions, the role of energy innovations, and mitigation strategies
- Provide insights into climate change impacts, adaptations, and the effects of combined, multiple stressors
- Develop global, national, and regional perspectives within economic and other policy-relevant frameworks



Partnerships with Advanced Scientific Computing Research

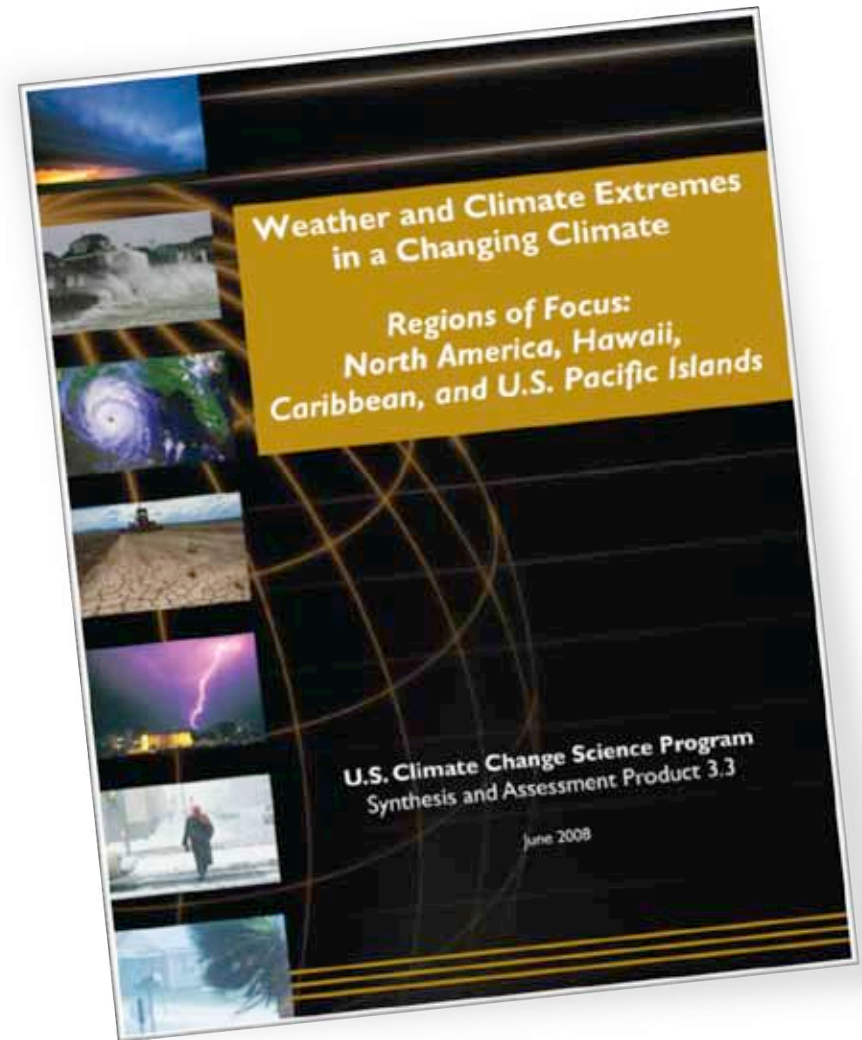
- The Scientific Discovery through Advanced Computing (SciDAC) program applies computational science expertise to critical aspects of climate change science
- The Innovative and Novel Computational Impact on Theory and Experiment (INCITE) program provides computational time to BER projects in climate modeling that need very large allocations
- The National Energy Research Scientific Computing (NERSC) facility provides a significant amount of smaller allocations for climate change research
- The Energy Sciences network (ESnet) provides scientific network capability for climate scientists to share data via the Earth Systems Grid

- Recent Joint Meeting on ESnet Scaling modeling; Mid-range Computing; Extreme scale Computing for Climate Change; NERSC requirements workshop



Coordinating U.S. Climate Change Research

- All BER climate change research is coordinated with the interagency U.S. Global Change Research Program (USGCRP)
- USGCRP integrates federal research on climate and global change among 13 federal agencies
- Joint program with NSF and USDA in Decadal and Regional Climate Prediction



**US Global Change
Research Program**
www.usgcrp.gov



Biological and Environmental Research

Systems science to meet DOE mission needs in bioenergy, climate and the environment.

